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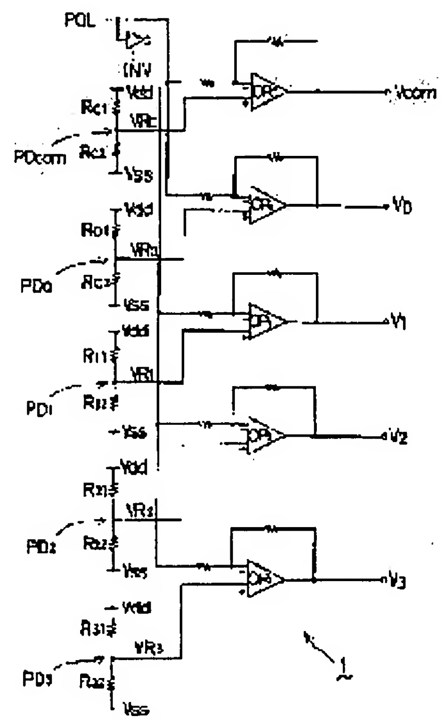
(71)Applicant : SHARP CORP
(72)Inventor : OKADA HISAO
YAMAMOTO YUJI
NISHITANI TADATSUGU
YANAGI TOSHIHIRO

(54) DRIVING CIRCUIT OF DISPLAY DEVICE



(57)Abstract:

PURPOSE: To decrease the extent of a DC component applied to a picture ele ment and to reduce the deterioration of the picture element and the flickering of an image by adjusting a common electrode voltage applied to a common electrode and the center value of respective gradation voltages independently of each other.

CONSTITUTION: The center value of the output voltage Vcom of an operational amplifier OPC deviates by a deviation from the center value of the output voltages V0-V3 of other operational amplifiers OP0-OP3. At the timing of the positive voltage application of the voltage V3, a voltage V+3 applied to the picture element is the sum of the voltage V3 and deviation. The value of the deviation is determined by properly setting the values of output voltages VRC and VR3 of resistance dividers. At the negative voltage timing of the voltage V3, on the other hand, a voltage V3-* applied to the picture element is the voltage obtained by subtracting the deviation from the voltage V3. For the purpose, the voltages V3+ and V3-* are controlled by properly selecting resistance values so that no DC voltage is applied to the picture element, and the

same transmissivity is obtained at the positive timing and negative timing.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to drive circuits, such as the display with which a possibility that it may be deteriorated or destroyed if direct current voltage is impressed has some for which a video signal needs especially an alternating current drive about the drive circuit of the display given in digital one, i.e., the picture element which constitutes the display screen, for example, a liquid crystal display etc.
[0002]
[Description of the Prior Art] This invention explains a TFT-liquid-crystal display as an example as the representative here, although a video signal is given in digital one and may be applied to the drive circuit of the display by which an alternating current drive is carried out.
[0003] As a source driver of the TFT-liquid-crystal indicating equipment with which a video signal is given in digital one, a drive circuit as shown in drawing 6 is used. In addition, since it is easy here, video-signal data shall consist of 2 bits. That is, it has four values of 0-3, the electrical potential differences V0-V3 for gradation supplied from the electrical-potential-difference feed zone 1 are chosen corresponding to each value, and video-signal data serve as an output. Drawing 7 is what shows the part corresponding to the n-th output among those. This circuit D-flip-flop (sampling flip-flop) MSMP of the 1st step and the flip-flop MH of the 2nd step (hold flip-flop) which were formed in each bit (D0, D1) of every [of video-signal data] It is constituted by the analog switches ASW0-ASW3 respectively formed at one decoder DEC and it between four sorts of gradation electrical potential differences V0-V3, and the source line On. In addition, the sampling of digital image **** data can use various things besides a D flip-flop.
[0004] This digital source driver operates as follows. The video-signal data D0 and D1 are incorporated by the sampling flip-flop MSMP at the standup time of the sampling pulse TSMPn corresponding to the n-th picture element, and are held there. When the sampling of 1 level period is completed, an output pulse OE is given to the hold flip-flop MH, and the video-signal data D0 and D1 currently held at the sampling flip-flop MSMP are outputted to Decoder DEC while they are incorporated by the hold flip-flop MH. Decoder DEC decodes this 2-bit video-signal data (D0, D1), and outputs either of four sorts of gradation electrical potential differences V0-V3 to the source line On according to that value (0-3) by considering any one of the analog switches ASW0-ASW3 as a flow.
[0005] The voltage waveform of the gradation electrical potential differences V0-V3 and the common electrode voltage Vcom applied to the common electrode of a liquid crystal panel is shown in drawing 8 . In addition, the electrical potential difference on which a gradation electrical potential difference is impressed to a picture element in order of V0-V3 shall become high (that is, $|V0-Vcom|<|V1-Vcom|<|V2-Vcom|<|V3-Vcom|$ and this relation may be reverse). Like illustration, each electrical potential differences V0-V3 and Vcom are changing between two voltage levels by turns synchronizing with the signal POL reversed for every 1 output period. Moreover, it is determined that each voltage level becomes symmetrical to a certain suitable electrical potential difference (main electrical potential

difference) VM.
[0006] The gradation electrical potential differences V0-V3 seen from the common electrode with which an electrical potential difference Vcom is impressed to drawing 9 are shown. Considering a certain picture element, the picture element will be charged on the electrical potential difference of drawing 9 while the picture element is chosen by the gate driver (driver for a scan). What is necessary is just to control by timing as which the picture element is chosen next temporarily, now, to become the negative (lower than the common electrode voltage Vcom) timing of illustration, supposing that time is the forward (higher than the common electrode voltage Vcom) timing of illustration. Thus, by controlling, the electrical potential difference which changes between positive/negative for every 1 display period, i.e., alternating voltage, can be given to a picture element, and it can prevent that the direct current voltage as the average is built over a picture element.
[0007]
[Problem(s) to be Solved by the Invention] To be sure in the Prior art explained above, the direct-current impression to a picture element should be able to prevent in the ideal condition. However, in an actual liquid crystal display, a difference will arise between the gradation electrical potential differences V0-V3 and the common electrode voltage Vcom used as the input voltage of the drive terminal of a liquid crystal panel, and the electrical potential difference actually built over the picture element inside a panel itself.
[0008] The reason which this difference produces is explained below. The picture element capacity CLC and the auxiliary capacity CS show the transparency circuit of the picture element section of a configuration of connecting with juxtaposition to the common electrode COM at drawing 12. Cgd in drawing is the parasitic capacitance between the gate drains of TFT10. When the gate line On becomes yes (VGH), TFT10 turns on, the electrical potential difference VS of the source line On is now impressed to a picture element and the charge charged by each capacity is set to q1, q2, and q3 as shown in drawing 13 , it is q1+q2+q3=constq1/CLC=q2/CS=VSq3=Cgd- (VS-VGH).
It becomes. These formulas (CLC+CS+Cgd) -VS=const+Cgd-VGH (formula 1)
**********.
[0009] on the other hand -- the gate -- a line -- On -- a low (VGL) -- becoming -- TFT -- ten -- turning off -- **** -- a case -- **** -- the -- the time -- each -- capacity -- charging -- having -- a charge -- drawing 14 -- being shown -- as -- q -- one -- ' -- q -- two -- ' -- q -- three -- ' -- ** -- carrying out -- if -- q1 -- '+q2'+q3' -- =constq1 -- '/CLC=q2' -- /CS=VS'q3'=Cgd- (VS' - VGL)
It becomes. These formulas (CLC+CS+Cgd) -VS'=const+Cgd-VGL (formula 2)
**********.
[0010] (Formula 1) and (formula 2) -- VS-VS'=Cgd-(VGH-VGL)/{CLC+CS+Cgd} (formula 3)
It becomes.
[0011] Thus, the gate line On changes to VS', after as for a picture element the period of yes (VGH) charges on an electrical potential difference VS and TFT10 becomes off at it, and as for the electrical potential difference of a picture element, it turns out that the difference is expressed with (a formula 3). Since electrical-potential-difference VS' actually drives a picture element, an above-mentioned difference will arise.
[0012] Generally this difference is observed as a difference in the property in the timing of the positive/negative of the liquid crystal panel seen from the drive terminal of a panel. Therefore, in the drive of drawing 8 , direct current voltage will be somewhat impressed to a picture element in an actual panel.
[0013] If the voltage levels of the positive/negative concerning a picture element differ, even if it does not result in degradation destruction of a display, the properties (the case of liquid crystal permeability) of the picture element in the timing of positive/negative will differ. A flicker of an image (flicker) is produced as a concrete symptom in this case.
[0014] Moreover, the direct current voltage concerning a picture element not only causes degradation of a display, but after displaying a quiescence image, even if it erases an image, it brings about the so-called problem of the still picture after-image that a front image remains, for a while. This poses a big

problem like the terminal display for computers in the display with which a still picture display will be a subject rather.
[0015] The purpose of this invention has few degrees of the direct current voltage impressed to a picture element, and they are for a display property to offer the drive circuit of a good display.
[0016]
[Means for Solving the Problem] The drive circuit of this invention is a drive circuit of the display which a digital video signal is inputted and has a common electrode common to two or more picture element electrodes. The common electrode voltage and two or more gradation electrical potential differences which have two voltage levels, respectively are outputted. The electrical-potential-difference supply means which changes each of this common electrode voltage and a gradation electrical potential difference by turns among corresponding 2 voltage levels, According to an input digital video signal, choose as a list any of two or more of these gradation electrical potential differences they are, and it sends out to this two or more picture element electrode side. It has a voltage selection means to send out this common electrode voltage to this common electrode side, and this electrical-potential-difference supply means is made to output the common electrode voltage in which the median of 2 voltage levels differs from the median of 2 voltage levels of two or more of these gradation electrical potential differences, and the above-mentioned purpose is attained by that.
[0017] It is desirable that a gradation voltage adjustment means to adjust each 2 voltage level of two or more of these gradation electrical potential differences to said electrical-potential-difference supply means is established.
[0018] Moreover, other drive circuits of this invention are drive circuits of the display into which a digital video signal is inputted. The electrical-potential-difference supply means which outputs two or more gradation electrical potential differences which have two voltage levels, respectively, and changes each of this gradation electrical potential difference by turns among these 2 voltage levels, And according to an input digital video signal, it chooses any of two or more of these gradation electrical potential differences they are, and it has a voltage selection means to send out and a gradation voltage adjustment means to adjust each 2 voltage level of two or more of these gradation electrical potential differences is formed in this electrical-potential-difference supply means.
[0019] As for said gradation voltage adjustment means, it is desirable by adjusting the mean value of each 2 voltage level of two or more gradation electrical potential differences to adjust 2 voltage levels.
[0020]
[Example] This invention is explained below about an example.
[0021] An example of the relation between the permeability of the liquid crystal panel used for a liquid crystal display and the electrical potential difference of the impressed positive/negative is shown in drawing 10 . In drawing 10 , the electrical-potential-difference shaft is set that the relation between the absolute value of the electrical potential difference to a negative electrical potential difference and permeability is expressed in a straight line.. The absolute value of the electrical potential difference between the common electrode voltage Vcom required in order that VN+ and VN- in drawing 10 may obtain the same permeability at the time of forward electrical-potential-difference impression and negative electrical-potential-difference impression, respectively, and the gradation electrical potential difference VN (at the example of explanation, N is 0 and 3) is expressed, and deltaVN expresses the difference between electrical-potential-difference (absolute value) VN+ and electrical-potential-difference (absolute value) VN-.
[0022] The graph when taking the absolute value of the input voltage at the time of negative electrical-potential-difference impression along an axis of abscissa, and taking deltaV along an axis of ordinate at drawing 11 is shown. Drawing 11 shows that there is the need of impressing the electrical potential difference which applied the value of an axis of ordinate to the absolute value of the input voltage at the time of negative electrical-potential-difference impression at the time of forward electrical-potential-difference impression, in order to obtain the same permeability. The case (in namely, the case of the gradation electrical potential difference V3) of N= 3 is explained more to a detail as an example. Now, the case where a liquid crystal panel is driven by the voltage waveform of drawing 11 is considered. The

absolute value of the electrical potential difference between the common electrode voltage Vcom in this case and the gradation electrical potential difference V3 presupposes that it is the electrical potential difference shown in drawing 10 as V3. In this case, since a difference arises on the electrical potential difference which joins the picture element of a liquid crystal panel as mentioned above in the time of forward electrical-potential-difference impression and negative electrical-potential-difference impression, the difference of the permeability shown by deltat3 of drawing 10 will occur to the timing of forward electrical-potential-difference impression and negative electrical-potential-difference impression.

[0023] In the 1st example of this invention, it is said by adjusting the common electrode voltage Vcom that deltaV of drawing 10 will be compensated. The voltage waveform of the gradation electrical potential difference V3 and the common electrode voltage Vcom after adjustment is shown in drawing 2 . Like illustration, by shifting the central value of the common electrode voltage Vcom from VM, the electrical potential difference at the time of forward timing can be adjusted from the electrical potential difference at the time of negative timing so that only deltaV3 may become high. That is, it becomes possible to give the electrical potential difference of V3+ of drawing 5 , and V3- to the drive terminal of a liquid crystal panel.

[0024] The electrical-potential-difference feed zone 1 in the 1st example of this invention is shown in drawing 1 . This example equips the operational amplifier OPC and list for generating the common electrode voltage Vcom with the operational amplifiers OP0-OP3 for generating the gradation electrical potential differences V0-V3, respectively. Signal POL is given to the reversal input of operational amplifiers OPC, OP0, and OP1, and Signal POL is given to the reversal input of operational amplifiers OP2 and OP3 through Inverter INV. The resistance-type potential divider PDC and the output of PD0-PD3 are given to each operational amplifier OPC and the noninverting input of OP0-OP3, respectively. From each operational amplifier OPC of such a configuration, and OP0-OP3, an electrical potential difference Vcom, and V0-V3 which vibrate by making applied voltage of each noninverting input into a median synchronizing with Signal POL are outputted. However, it is an opposite phase mutually on an electrical potential difference Vcom, and V0 and V1 and electrical potential differences V2 and V3. The amplitude value of these electrical potential differences becomes settled with the amplification factor of each operational amplifier.

[0025] Each resistance-type potential divider PDC, and PD0-PD3 consist of two fixed resistance, the end of one resistance is connected to the power source Vdd of + potential, and the end of resistance of another side is connected to the power source Vss of ground potential. Therefore, the electrical potential difference VRC of the node of two fixed resistance RC1 and RC2 which constitutes a resistance-type potential divider PDC serves as {RC2/(RC1+RC2)} Vdd. The electrical potential difference VRC of this node is given to the noninverting input of an operational amplifier OPC as mentioned above as output voltage of a resistance-type potential divider PDC. Similarly it sets to resistance-type potential dividers PD0-PD3. The electrical potential differences VR0-VR3 of the node of R31 and R32 in fixed resistance R01, R02 and R11 and R12, R21 and R22, and a list, respectively {R02/(R01+R02)} It is set to Vdd, {R12/(R11+R12)} Vdd, {R22/(R21+R22)} Vdd, and {R32/(R31+R32)} Vdd.

[0026] Therefore, the value of the output voltage VRC, VR0-VR3 of each resistance-type potential divider is determined by setting up the resistance ratio of each fixed resistance of both suitably. In this example, since it is referred to as RC2/RC1<R02/R01=R12/R11=R22/R21=R32/R31, it is set to VRC<VR0=VR1=VR2=VR3.

[0027] So, as shown in drawing 2 , as for the central value VMcom of the output voltage Vcom of an operational amplifier OPC, only deflection delta VM shifts to a low-battery side from the central value VM of the output voltage V0-V3 of other operational amplifiers OP0-OP3. In addition, by drawing 2 , in order to simplify illustration, only the electrical potential difference Vcom and the electrical potential difference V3 are shown. To the timing of forward electrical-potential-difference impression (namely, negative electrical-potential-difference impression of an electrical potential difference Vcom) of an electrical potential difference V3, electrical-potential-difference V3+ impressed to a picture element becomes what added deflection deltaVM to the electrical potential difference V3. The value of this

deflection deltaVM can be determined by setting up suitably the value (namely, value of both the fixed resistance of each resistance-type potential divider) of the output voltage VRC and VR3 of a resistance-type potential divider. On the contrary, to the timing of negative electrical-potential-difference impression (namely, forward electrical-potential-difference impression of an electrical potential difference Vcom) of an electrical potential difference V3, electrical-potential-difference V3- impressed to a picture element becomes what subtracted deflection deltaVM from the electrical potential difference V3. Therefore, resistance is chosen suitably, electrical-potential-difference V3+ and V3- are made not to be impressed by the picture element to direct current voltage, and permeability can become the same to the timing of positive/negative. In addition, correction is similarly performed only for deflection delta VM about the electrical potential difference impressed to a picture element based on other electrical potential differences V0-V2, and impression of direct current voltage is prevented. In addition, it is made for deflection deltaVM to serve as most suitable value between Rhine L0 of drawing 11 , and Rhine L3.

[0028] The electrical-potential-difference feed zone 1 in the 2nd example of this invention is shown in drawing 3 . In this 2nd example, it replaces with the resistance-type potential divider PDcom in the 1st example, and Potentiometer PMcom is formed. According to this configuration, the value of the output voltage VRcom of the potentiometer PMcom given to the noninverting input of an operational amplifier OPC can be adjusted suitably. Therefore, since adjustment also of the value of deflection deltaVM is attained, the value of deflection deltaVM can be adjusted according to the display property for every display.

[0029] The electrical-potential-difference feed zone in the 3rd example of this invention is shown in drawing 4 . In this 3rd example, it replaces with the resistance-type potential dividers PD0-PD3 in the 1st example, and potentiometers PM0-PM3 are formed, respectively. The output voltage VR0-VR3 of the potentiometers PM0-PM3 given to the noninverting input of operational amplifiers OP0-OP3 can be adjusted independently, respectively. According to this configuration, the value of deflection deltaVM to each of the gradation electrical potential differences V0-V3 can be adjusted independently. Therefore, all gradation electrical potential differences can be adjusted independently, and the optimal display property can be acquired in all gradation.

[0030] It can also consider as the configuration which transposes all the resistance-type potential dividers PDC in the 1st example, and PD0-PD3 to a potentiometer combining the 2nd above-mentioned example and 3rd above-mentioned example. It becomes possible to adjust independently each of the common electrode voltage Vcom and the gradation electrical potential differences V0-V3 in the case of this example.

[0031] It can also consider as the operational amplifier OPc in each above-mentioned example, and a configuration as show the configuration of OP0-OP3 to drawing 5 . With this configuration, the output of an operational amplifier OP is amplified by the bidirectional current amplification circuit AM which used two transistors Q1 and Q2. Therefore, with the application of this configuration, each common electrode voltage or a gradation electrical potential difference, then the same effectiveness are acquired by each above-mentioned example in the output of the current amplification circuit AM. It is good if enough to drive transistors Q1 and Q2 as current capacity of an operational amplifier OP according to this configuration. So, it becomes possible to use an operational amplifier with small current capacity.

[0032]

[Effect of the Invention] According to this invention, the degree of the dc component impressed to a picture element can be made small.

[0033] If the voltage levels of the positive/negative concerning a picture element differ, even if it does not result in degradation destruction of a panel, the permeability in the timing of positive/negative will differ as mentioned above, and a flicker of an image (flicker) will be produced as a concrete symptom. By this invention, a flicker of an image can be lessened sharply.

[0034] In addition, this flicker can be observed for every gradation and a voltage adjustment means can also be adjusted. In this case, as for the pattern displayed on the screen of a display, it is desirable to use the pattern with which it is made to differ for every gradation, and a flicker becomes the most

remarkable in that gradation.

[0035] After the direct current voltage concerning a picture element displays a quiescence image, even if it erases an image, it it not only causes degradation of liquid crystal, but brings about the so-called problem of the still picture after-image that a front image remains for a while. This poses like a computer a big problem as a display of the equipment with which a still picture display will be a subject rather. By this invention, this still picture after-image can be lessened sharply.

[0036] As mentioned above, this invention amends the property difference in the positive/negative of a liquid crystal display, and the display which raised dependability and display grace far compared with amendment before can be realized. That is, the effectiveness acquired by this invention is very large.

[Translation done.]

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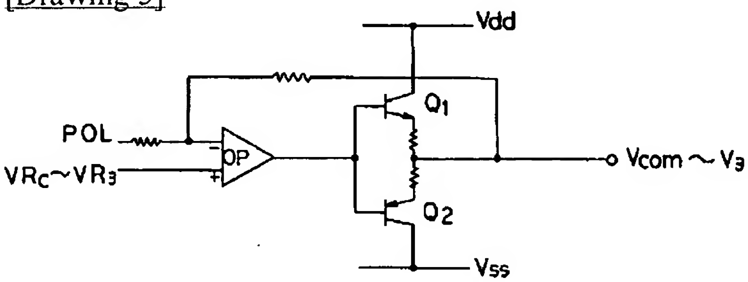
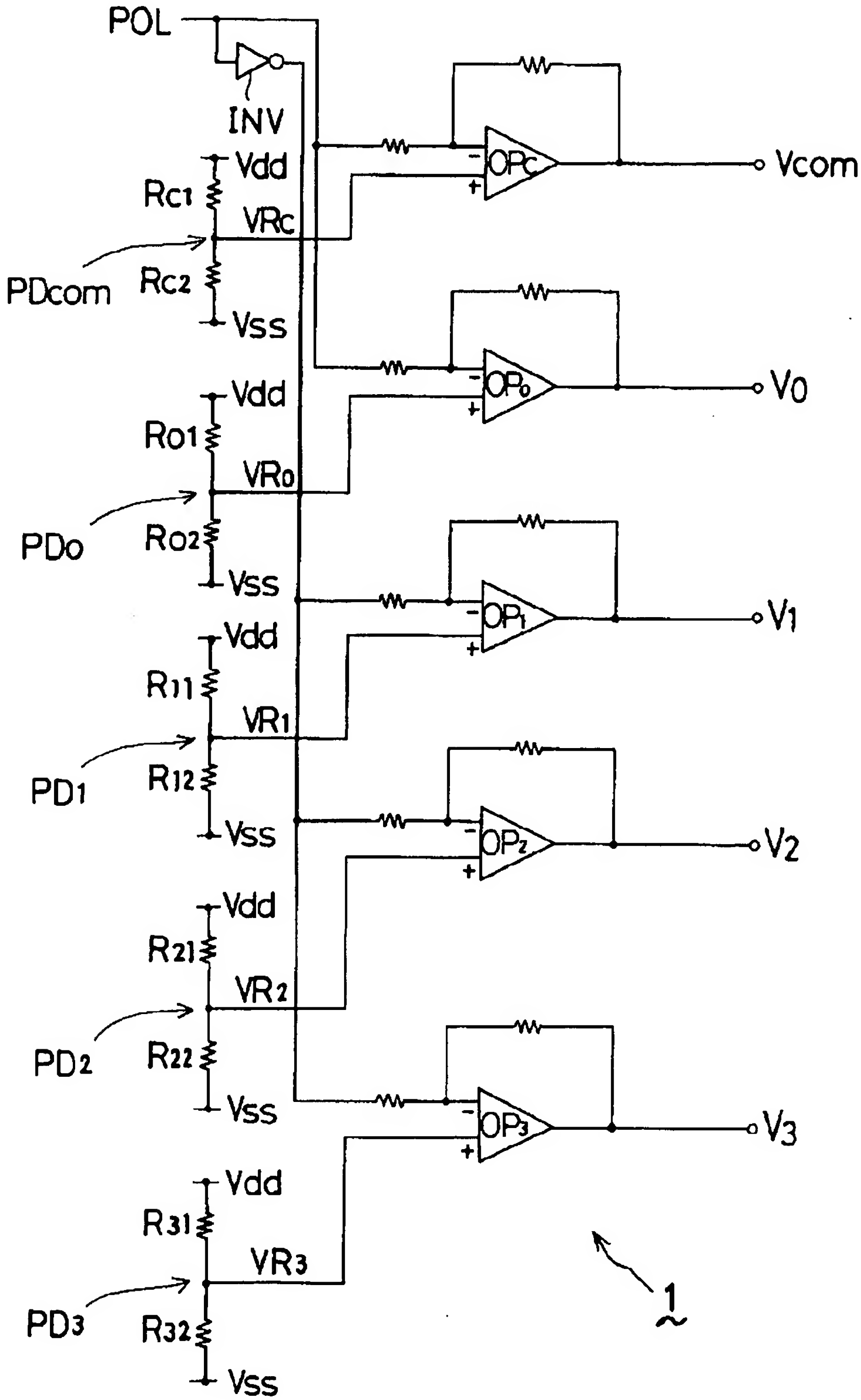
DRAWINGS

[Drawing 5]



[Drawing 1]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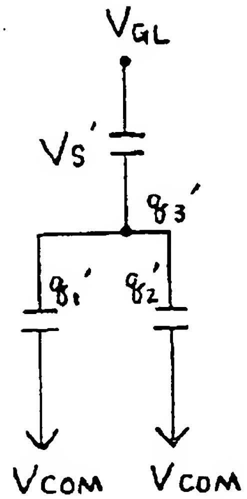
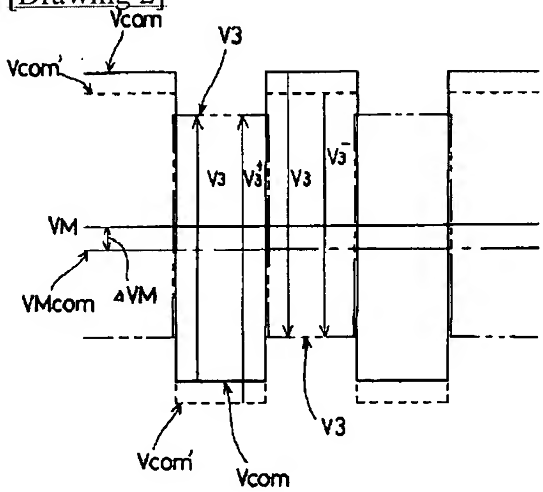
[Drawing 14]



[Drawing 2]



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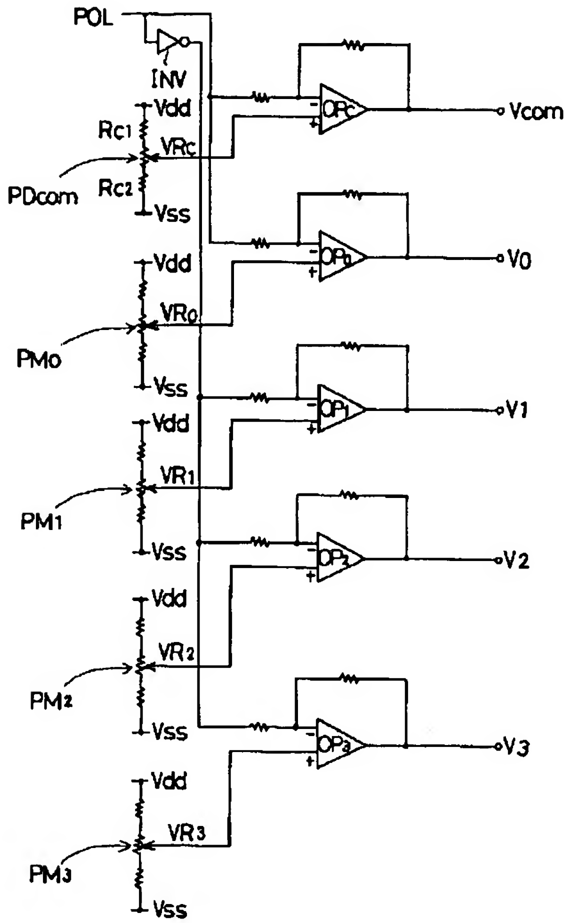
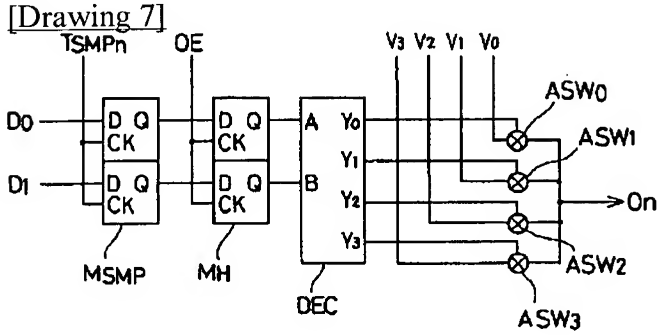
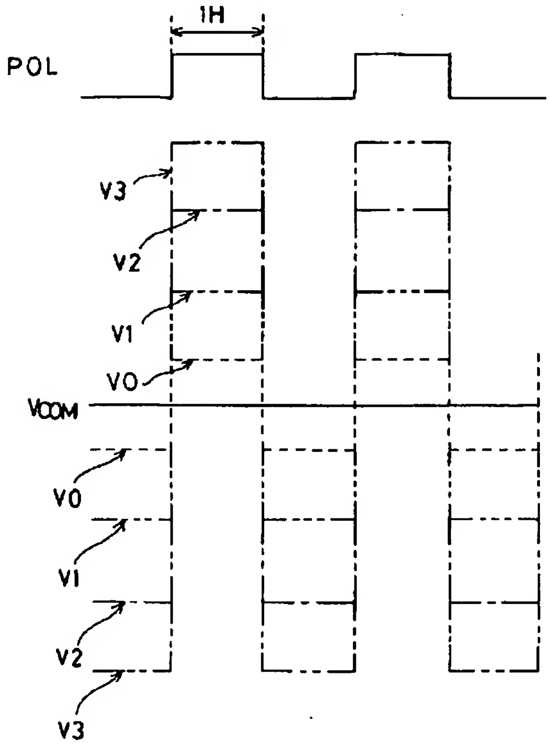


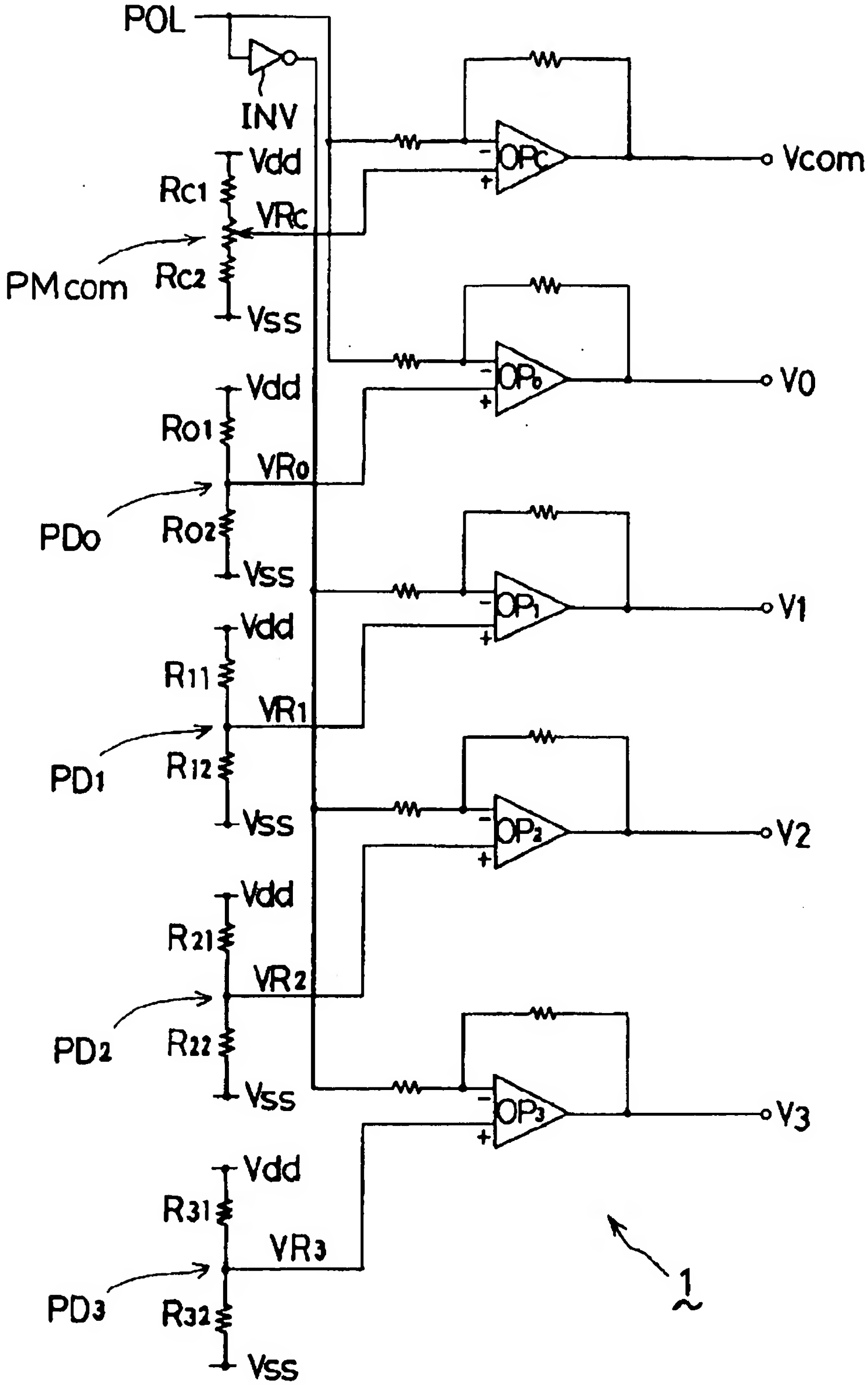
[Drawing 7]



[Drawing 9]



[Drawing 3]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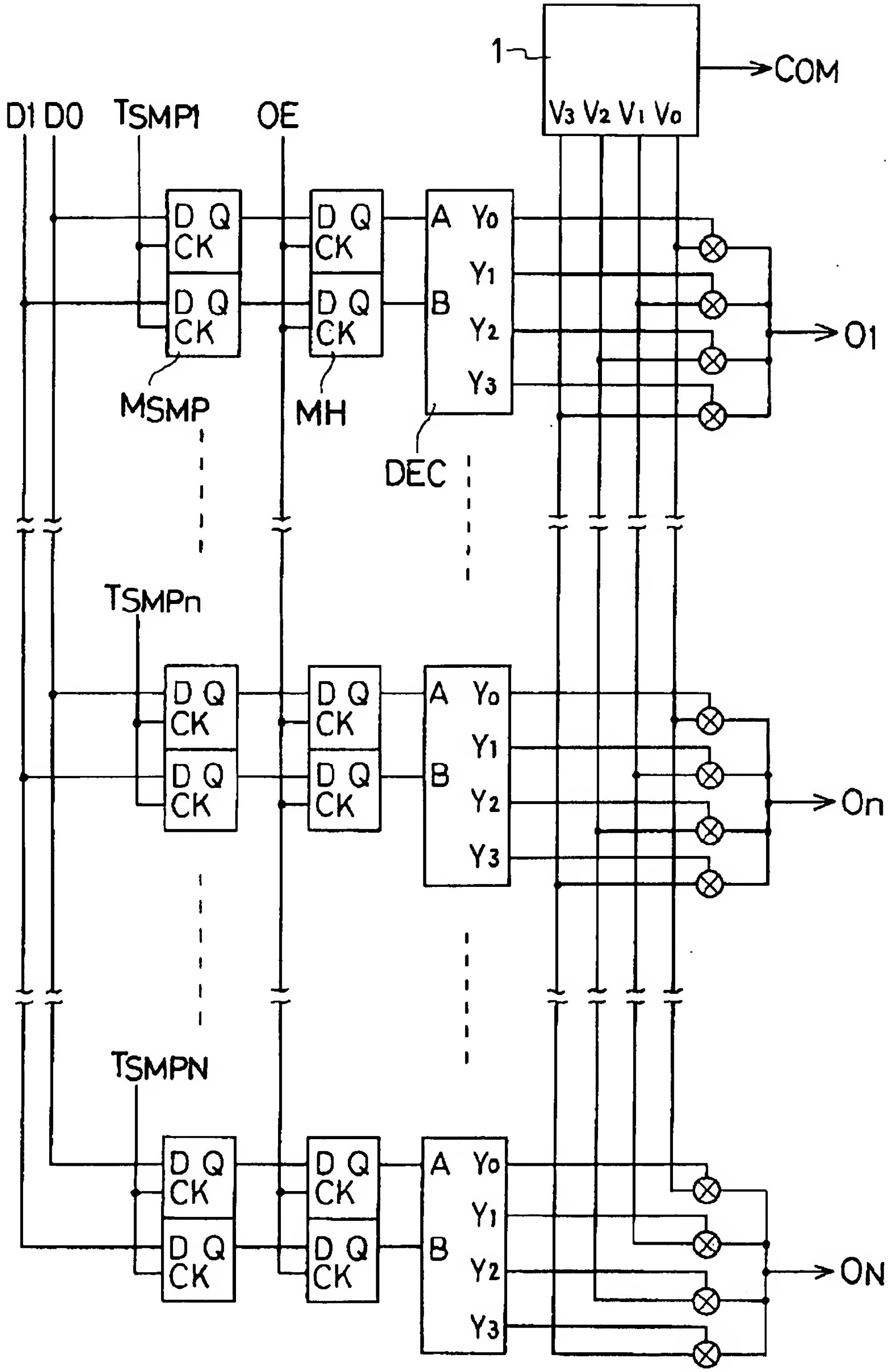
[Drawing 6]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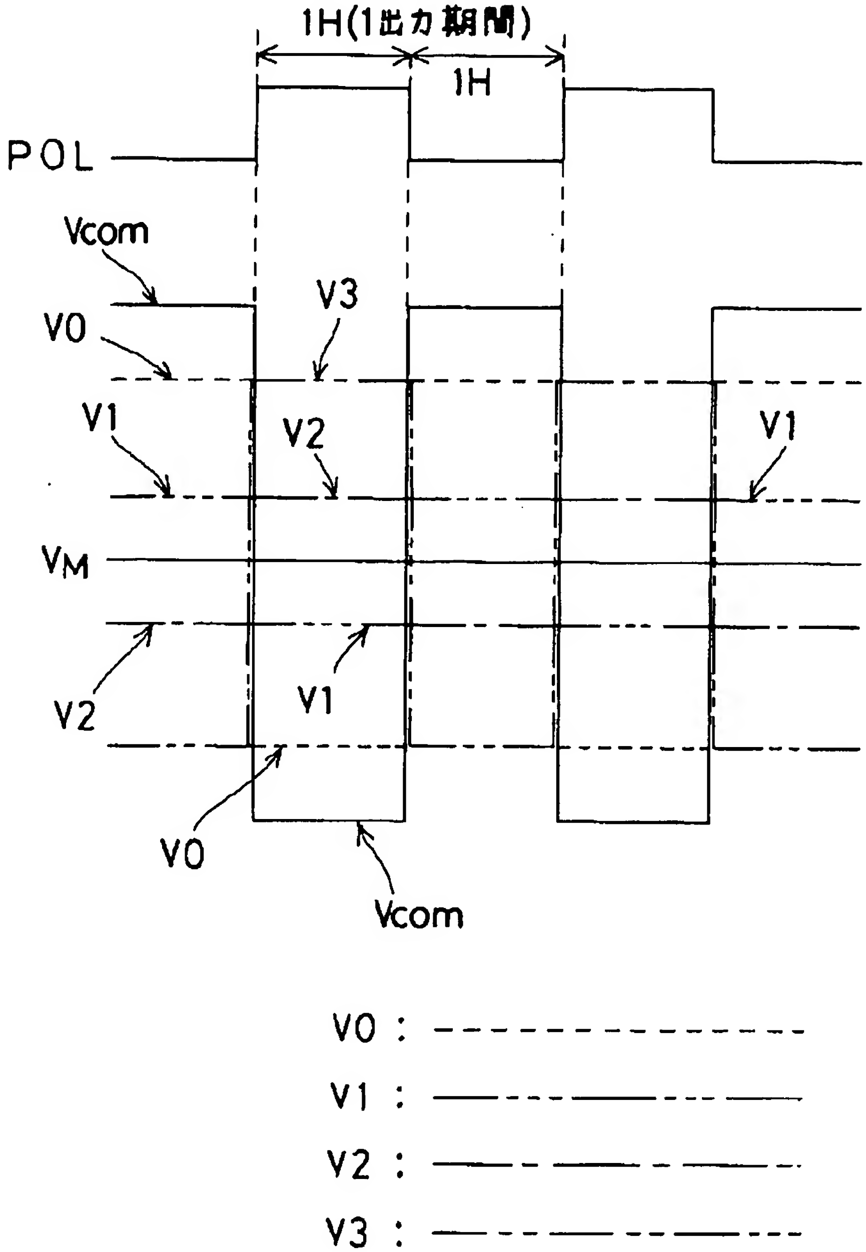
[Drawing 8]



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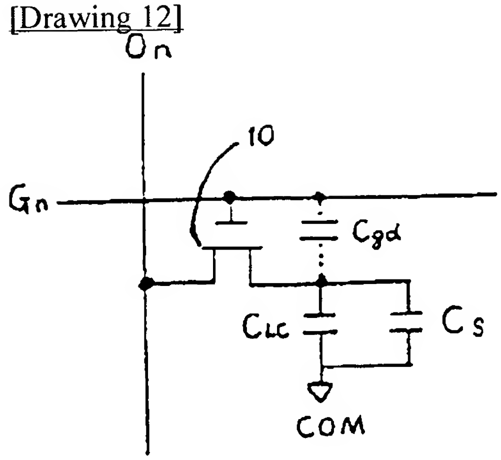

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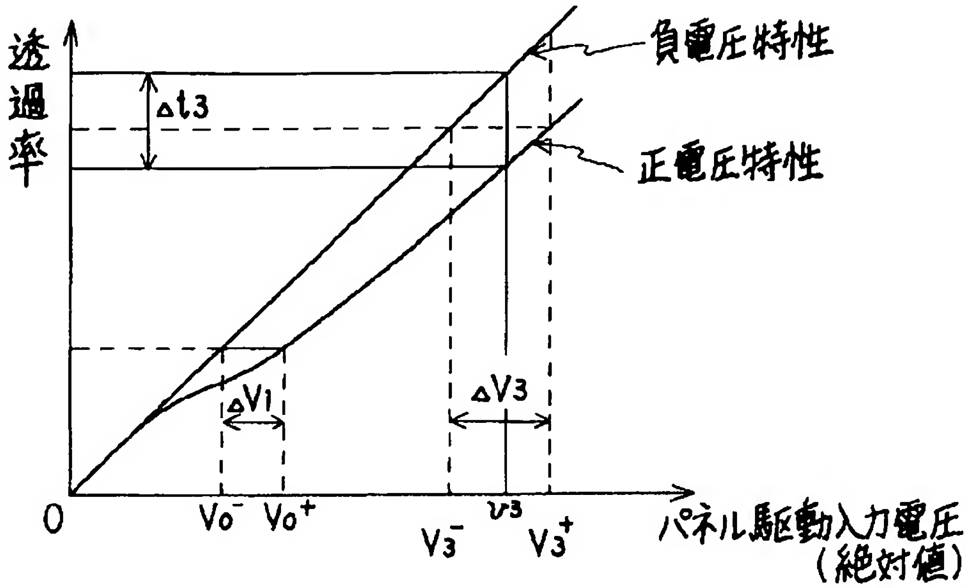
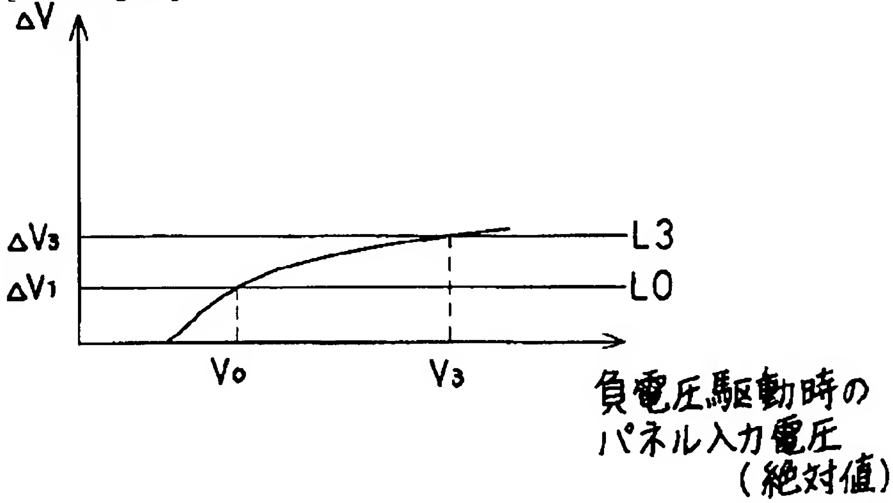
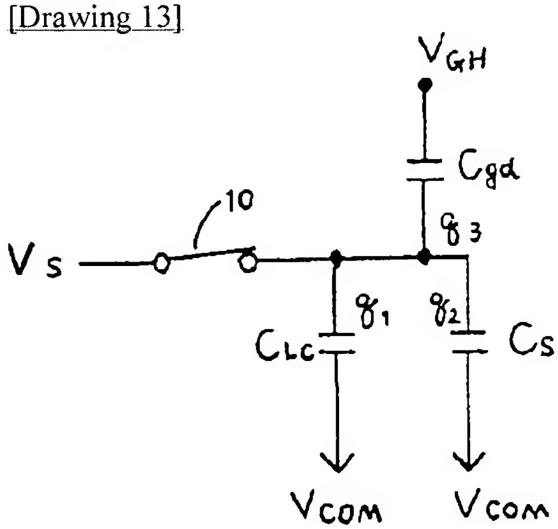


[Drawing 11]



[Drawing 13]



[Translation done.]